Thermal Transport in Thin Metallic Films Excited by Femtosecond Optical Pulses

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Femtosecond optical pulses are used to drive magnetisation dynamics in time-resolved Kerr imaging techniques [1]. In metals, a significant proportion of the optical energy is absorbed as heat. If the pulse is ultrashort and tightly focused, the resulting temperature distribution is both transient and non-uniform. This makes it a vital property underpinning any wave phenomena that could be excited in the sample.

We use the three-temperature model (including electrons, phonons, spin) in finite element simulations to find the transient temperature distribution for a thin film metallic sample (Fig. 1). This temperature distribution is then fed into micromagnetic simulations with the aim of finding magnonic normal mode spectra.

[1] Y. Au et al., Phys. Rev. Lett. 110, 097201 (2013)

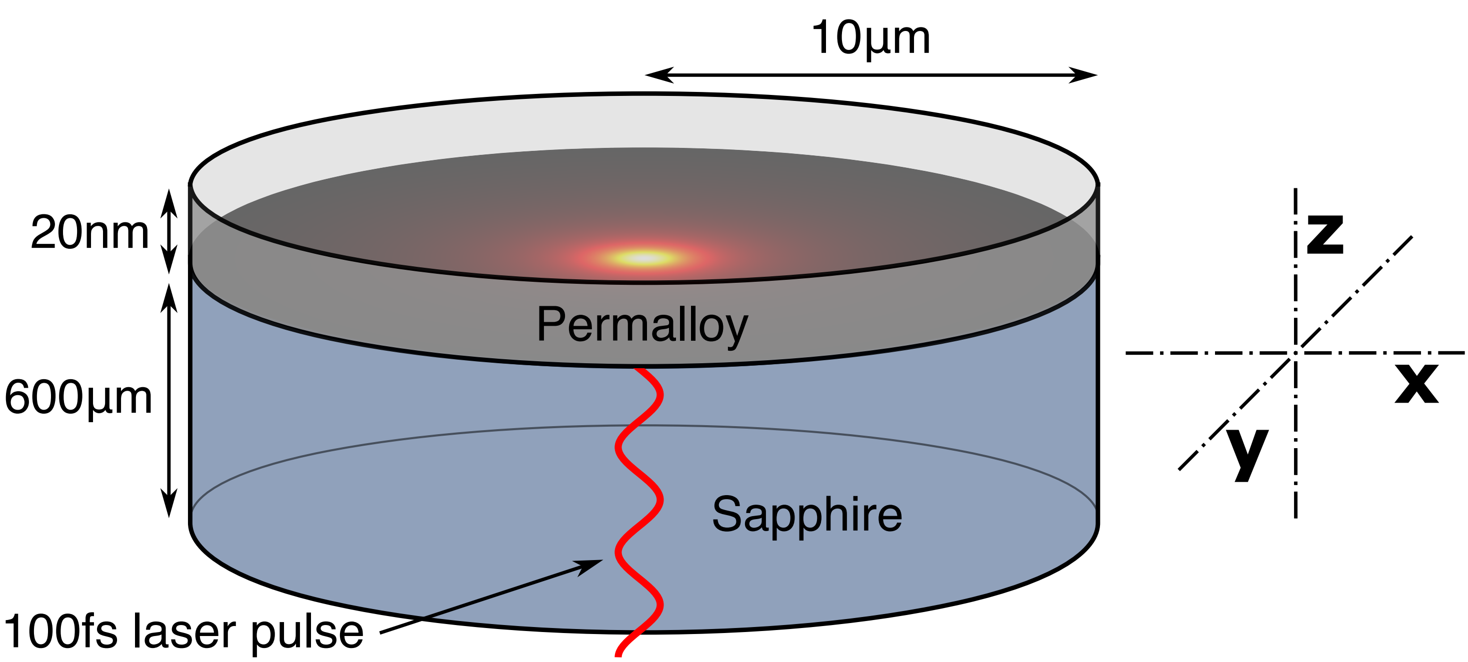

Fig. 1: Diagram of our model set up with simulation results superimposed. A 800nm ultrafast laser pulse travels through a transparent sapphire substrate, heating the bottom of a permalloy film. It is fully absorbed, heating the surrounding area, dissipating into the sapphire. The results shown are calculated for an infinite series of pulses with a 12.5ns seperation.